



Misconceptions for concepts in sciences in Charles Perrault's fairy tales

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ABSTRACT

This study examines the accuracy of the content of Charles Perrault's fairy tales in terms of sciences. Qualitative content analysis was used to analyze seven fairy tales. The texts were examined to identify and record the scientific mistakes and inaccuracies and the alternative ideas they may create in children. Errors and inaccuracies were organized into a four-category system. The results provide teachers with incorrect representations of physical concepts and phenomena in fairy tales. Finally, proposals are presented for utilizing these books in teaching sciences.

Keywords: misconceptions, science, content analysis, fairy tales, Charles Perrault

INTRODUCTION

Children's literature is important in cross-curricular science teaching and learning (Trundle et al., 2008). Children's books, fiction, and non-fiction increase learning outcomes in the field of reading and writing, and physics (Morrow et al., 1997; Rice, 2002).

A characteristic difference between fiction and non-fiction sources is the reader's transportation into the world of the narrative (Gerrig, 1993). The reader is transported into the story when he visualizes the events, connects emotionally with the characters, does not perceive other events in the reading space, and has specific preferences for its outcome (Green & Brock, 2000). The reader's transference is related to the reduction of his ability to critically evaluate the information provided by the story (Gerrig & Rapp, 2004) and to access his prior knowledge (Gerrig, 1989). Therefore, mistakes and inaccuracies in stories can act as a means of misinforming the world. Empirical studies have concluded that errors and inaccuracies in children's books, especially fiction books, create alternative ideas in children (Mayer, 1995; Rice, 2002). In Mayer's (1995) research, children learned new facts about whales from the fiction book. However, they also built alternative ideas like whales jumping from lakes to oceans. Research by Rice (2002) reached similar conclusions. Although the children had prior knowledge about whales and their behavior, they could not spot the inaccuracies in the book.

Content analyses of children's literature books identified errors and inaccuracies in science. Most researchers, however,

have focused on representing a single subject, for example, the moon (e.g., Trundle et al. 2008). Furthermore, in most research, the sample was mainly science trade books (e.g., Schussler 2008). Children, however, come into contact with other types of children's literature, such as fairy tales. It seems that even fairy tales lead to the creation of alternative ideas. Students, for example, after reading the fairy tale Goldilocks and the three bears, formed alternative ideas about temperature and volume (McClelland & Krockover, 1996). As far as fairy tales are concerned, those of Andersen, Perrault, and the Brothers Grimm are considered particularly popular as they have been translated into many languages (Zipes, 2015). Indeed, the accuracy of their content has been examined in terms of environmental sciences (Kazantzidou & Kotsis, 2017, 2023a, 2023b), but not in terms of sciences. Also, the accuracy of the content of fairy tales has been examined for celestial bodies (Kazantzidou & Kotsis, 2023c).

The present research, therefore, aims to identify the mistakes and inaccuracies in concepts of Sciences in Charles Perrault's fairy tales as well as the alternative ideas they may create in children. The research questions are, as follows:

1. What are the inaccuracies and errors in relation to concepts and phenomena of the Sciences found in the text of the fairy tales? Errors are expressions that show a misunderstanding of the phenomena and concepts of the Sciences. Inaccuracies are expressions also used in everyday life and represent the prevailing scientific opinions differently.
2. What alternative ideas might be generated in children due to these errors and inaccuracies?

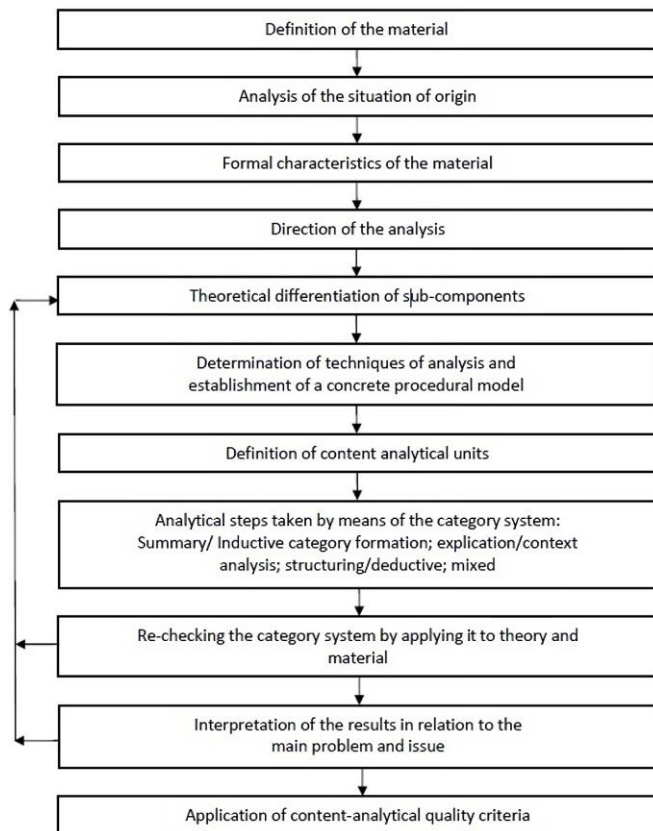


Figure 1. Stages of research according to Mayring (2014)

METHODOLOGY

Research method used was qualitative content analysis, as described by Mayring (2014) (**Figure 1**). Analysis was done with the QCAMap web application (<http://www.qcmap.org/>).

Convenience sampling with qualitative and quantitative criteria was used to determine the sample. Libraries were chosen to collect the books, as their materials are freely available to people of all ages. Initially, a search was made with the term “Perrault” in the catalog of the Municipal Library of Veria and the Library Network of the Municipality of Thessaloniki in Greece. A list was then created of the titles of the books identified, the age of children each was aimed at, and the year of publication. Because many books had the same title, those containing a single tale were initially selected to include multiple publishers. Based on age of children and the year of publication, the book that was aimed at older children and was published most recently was chosen each time.

This criterion was set because books intended for younger children are more comprehensive and shorter, resulting in important plot elements being omitted (O’Sullivan, 2010). Then, the titles of the fairy tales contained in collections were recorded, and the fairy tales not found circulating in individual books were selected. The final sample, therefore, included seven Perrault fairy tales, six from individual books, and one from a book with a collection of fairy tales released between 1993 and 2015 and aimed at children of preschool and school age. The list of fairy tales is “Cinderella: The sleeping beauty”, “The princess in the donkey skin”, “Puss in boots,” “Bluebeard,” “The fairies,” and “Little red riding hood.” Regarding the typical characteristics, the text of the fairy tales,

which was translated into Greek, was studied. Although Perrault wrote the fairy tales in French, four of the fairy tales in the study were originally in French, and the remaining three were in English, Italian, and Spanish.

The direction of the analysis was defined based on Laswell’s classic communication scheme (1949, as cited in Bonidis, 2004). According to this, the study of communication is summed up in the questions: who is speaking, what is he saying, to whom is he speaking, for what purpose, how is he saying it, and what is the effect of the speech? In this study, therefore, the investigation of the content of the message, i.e., mistakes and inaccuracies in sciences, and the effect it can have on the acceptance group, i.e., the alternative ideas that can be created in children, is attempted.

Inductive category formation was defined as the analysis technique, as categories with errors and inaccuracies were formed after examining the material. In the next step, the units of analysis were defined, which “constitute specific parts of the text in which the occurrence or reference of the requested variables (properties-categories) is investigated” (Bonidis, 2004). Specifically, Seme was chosen as the coding unit. This unit constitutes a proposal or statement regarding the research questions. All texts were defined as frame and log units by the software itself. Finally, the category definition was formulated as a criterion for selecting the material from the texts. Specifically, the definition was defined as any reference to the texts that do not represent in a scientifically acceptable way concepts or phenomena of the Sciences and can lead to alternative ideas (Driver et al., 2000). Then, the level of abstraction was formulated, that is, how limited or not the content of the categories will be. Therefore, this was defined as the broadest field of sciences in which each category is included: Astronomy, Optics, etc.

Once all of the above was determined, all texts were entered into the software and read. When a passage was found that met the above conditions, it formed a category or belonged to an existing one. Finally, to check the reliability and establish a system of categories, the same researcher used an agreement in the coding at two different times (intra-coder agreement), namely after six months.

RESULTS

A total of 52 passages were recorded in the fairy tales, with mistakes and inaccuracies in concepts of sciences, which can lead to the creation of alternative ideas in children. These excerpts were organized into a four-category system: astronomy (23%), optics (31%), engineering (29%), and miscellaneous (17%). According to Mayring (2014), the content analysis results in a list of categories, including the title of each category, the definition, examples from the texts, and coding rules, where necessary.

The results are therefore given in table form (**Table 1**), including the categories list. However, the scientific view and alternative ideas were added for the needs of this research.

Scientific view provides the prevailing scientific view of the phenomena recorded, while the alternative ideas provide the possible alternative ideas that may be generated in children.

Table 1. Category system

Category	Category definition	Examples	Scientific view	Alternative ideas
Astronomy	This category includes any reference that does not represent the Moon & the Sun in scientifically accepted way & can lead to alternative ideas about (a) light of the Moon, as it presents itself as self-luminous, (b) day-night sequence, astronomical movement of the Sun, & the Sun-Earth distance, & (c) also, included are anthropomorphic elements attributed to the Sun & the Moon.	(a) "... she shone so sweetly, as neither moon nor sun ever shone" (The sleeping beauty), (b) "... wait for night to fall ..." (The princess in the donkey skin), & (c) "... in a kingdom so vast that only the sun knew where it began and where it ended ..." & "the moon was jealous ..." & refused to go out into the sky ..." (The little princess with the donkey).	(a) The Moon reflects light of the Sun that falls on its surface, it is a heterogeneous celestial body (Avgoloupis & Seiradakis, 2009), (b) Succession of day & night is due to rotation of the Earth on its axis every 24 hours, & (c) Successively a place on its surface passes from shadow to light. Average distance of the Sun from the Earth amounts, to approximately, 149,600,000 kilometers.	(a) The Moon shines, it emits its own light like the Sun, & it is self-luminous, (b) The Sun is covered by darkness/night. The Sun is close to, on, or accessible to Earth, & (c) The Moon is a living organism, that sees, has feelings (e.g., jealous), & appears at will. The Sun is a living organism, it sees, it has knowledge.
Optics	This category includes any reference that does not represent phenomena related to optics in a scientifically acceptable way & can lead to alternative ideas related to (a) vision & eye function, as eyes emit light rays, or their function is not linked to light & brain activity, (b) nature of light, as word light is also used for source that produces it, & (c) autoluminous & heteroluminous bodies, as some heteroluminous bodies glow.	(a) "The king's messenger was about to leave when his eye caught Cinderella ..." (Cinderella) & "The room was dark. As soon as the girl began to get used to the darkness ..." (The bluebeard), (b) "... she was led into the great ballroom, which was lit by hundreds of lights ..." (Cinderella), & (c) "... a magnificent dress, embroidered with so many rubies and diamonds, that it shone brighter than the sun..." (The princess in the donkey skin).	(a) When light rays reach eyes, they are refracted in crystalline lens of eye & focused on retina, where image is formed. Visual stimulus is carried to brain through optic nerve. To distinguish an object it must be illuminated (Hewitt, 2007), (b) Light is a transverse electromagnetic wave that is emitted from a source & carries energy (Hewitt, 2007), & (c) Heteroluminous bodies re-emit light incident on their surface from a primary or secondary light source (Hewitt, 2007).	(a) Vision is an active process. We see because light rays from our eyes fall on objects. That is, something escapes our eye in object. We see in dark. Sight is solely due to eyes, limited only to function of eyes. We see just by looking. Eyes work independently, (b) Light is identified with light source, & (c) Precious stones/gems, such as diamonds & rubies, gold glow, that is, they emit light, so they are self-luminous bodies. By extension, we see because objects send out their own light.
Mechanics	This category includes any reference that does not represent concept of force & weight in a scientifically acceptable way & may lead to alternative ideas, such as (a) strength is associated with muscular strength of living organisms, consumption of food, emotions, or social status of individuals & (b) weight appears as a property of bodies or relates to emotions.	(a) "Neither his riches nor his power will avail him ..." (The princess in the donkey skin) & (b) "... carrying heavy bucket full of water ..." (The fairies) & "No matter how heavy your sorrow is ..." (The princess in the donkey skin).	(a) A force applied to a body can deform it, stop it when it is moving, move it when it is stationary, or speed up or slow down its motion when it is moving. To exert a force on a body, existence of a second body is necessary. Force is attraction or repulsion (Hewitt, 2007) & (b) Weight is force exerted on a body due to gravity, $m \cdot g$ (Hewitt, 2007).	(a) Force is a property of bodies, of individual objects, & not an interaction between two objects. Thus, a man is strong, he has strength. Eating food increases one's strength. Someone who has power has "power"-term power is used in a different sense than in physics & (b) The bucket is heavy. An emotion, for example, distress or sadness, is heavy.
Others	This category includes passages that are either not classified in above categories or do not have any common characteristic to form a new category.	"... like vase suddenly overturned by wind" (The princess in the donkey skin) & "It was so cold that tears that glistened on her eyelids froze & rolled like diamonds down her velvety cheeks" (The princess in the donkey skin).	We do not feel still air. Air in atmosphere, however, moves. Movements of atmospheric air masses create phenomenon of wind. Quantity that tells us how cold or hot an object is called temperature.	Air is identified with wind, as it causes objects to move. Air & wind are same concepts. By extension, difficult to realize that air is everywhere around us. Cold & heat are substances/entities that exist around us & spread.

CONCLUSIONS

The present research shows that the seven fairy tales of Charles Perrault, which were studied, contain mistakes and inaccuracies in matters of science. Many reports are consistent with past theories regarding the individual characteristics of errors and inaccuracies. For example, the description of force as a property of bodies is related to the Aristotelian view. In addition, some passages interpret phenomena based on data received from the senses. The results are also linked to

expressions used in everyday life, while some concepts of physics, such as weight, are given a different meaning. Attributing different meanings to concepts can lead to difficulties understanding the corresponding scientific concepts.

One reason for these inaccuracies may be the time of writing. In the 17th century, when fairy tales were recorded, many theories of natural science did not match the scientific understanding of the 21st century. In addition, Perrault collected the fairy tales, which were known and spread only by word of mouth, to transform them into moral stories

acceptable to adults (Zipes, 2012). Therefore, its purpose was not for readers to enrich their knowledge of physics. Finally, alternative ideas of the translators or their adaptors may have been recorded in the fairy tales, as they are translation products.

The results are consistent with the conclusions of previous research that analyzed the content of children's knowledge books. For example, inaccuracies about the Moon were also recorded in the survey by Trundle et al. (2008). Consequently, children may construct alternative ideas or reinforce existing ones. However, we do not exclude the use of these books from the teaching of sciences. In the research of McClelland and Krockover (1996), children with appropriate guidance come into cognitive conflict and reconstruct the alternative ideas they have built. Performing experiments, making observations, and comparing fairy tales with accurate books of knowledge could lead to a critical approach to fairy tales and the building of scientific knowledge. Finally, a suggestion for further research is the empirical study of the effect of fairy tales on children's knowledge of science. These results could lead to proposals for the better use of these books in the learning and teaching of sciences.

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Availability of data and materials: All data generated or analyzed during this study are available for sharing when appropriate request is directed to corresponding author.

REFERENCES

- Avgoloupis, S., & Seiradakis, I. (2009). *Observational astronomy*. Planetarium.
- Bonidis, K. (2004). *The content of the textbook as an object of research: Longitudinal examination of the relevant research and methodological observations*. Metaichmio.
- Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V. (2000). *Building science concepts: A global compendium of student ideas*. Print.
- Gerrig, R. J. (1989). Suspense in the absence of uncertainty. *Journal of Memory and Language*, 28(6), 633-648. [https://doi.org/10.1016/0749-596X\(89\)90001-6](https://doi.org/10.1016/0749-596X(89)90001-6)
- Gerrig, R. J. (1993). *Experiencing narrative worlds: On the psychological activities of reading*. Yale University Press. <https://doi.org/10.12987/9780300159240>
- Gerrig, R. J., & Rapp, D. N. (2004). Psychological processes underlying literary impact. *Poetics Today*, 25, 265-281. <https://doi.org/10.1215/03335372-25-2-265>
- Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology*, 79, 701-721. <https://doi.org/10.1037/0022-3514.79.5.701>
- Hewitt, P. G. (2007). *The concepts of physics*. University Publications of Crete.
- Kazantzidou, D., & Kotsis, K. T. (2023a). Ozone layer depletion in children's books available in Greece: Examining accuracy in the representation of causes of ozone layer depletion in texts. *Children's Literature in Education*. <https://doi.org/10.1007/s10583-023-09524-0>
- Kazantzidou, D., & Kotsis, K. T. (2023b). Representation of the ozone layer in children's trade books about ozone layer depletion: An analysis of written texts in Greece. *Interdisciplinary Journal of Environmental and Science Education*, 19(1), e2302. <https://doi.org/10.29333/ijese/12847>
- Kazantzidou, D., & Kotsis, K. T. (2023c). Representations of the celestial bodies in fairy tale texts. *Aquademia*, 7(2), ep23005. <https://doi.org/10.30935/aquademia/13442>
- Kazantzidou, D., & Kotsis, K., T. (2017). Errors and inaccuracies about the environment in fairy tales: An analysis of written text. *Science Education Research & Praxis*, 61, 9-23.
- Mayer, D. A. (1995). How can we best use children's literature in teaching science concepts? *Science and Children*, 32(6), 16-19. <https://eric.ed.gov/?id=EJ676681>
- Mayring, P. (2014). Qualitative content analysis: Theoretical foundation, basic procedures and software solution. *Klagenfurt*. <http://nbn-resolving.de/urn:nbn:de:0168-ssoar-395173>
- McClelland, A. K., & Krockover, G. H. (1996). Children's understandings of science: Goldilocks and the three bears revisited. *Journal of Elementary Science Education*, 8(2), 52-65. <https://doi.org/10.1007/BF03173747>
- Morrow, L. M., Pressley, M., Smith, J. K., & Smith, M. (1997). The effect of a literature-based program integrated into literacy and science instruction with children from diverse backgrounds. *Reading Research Quarterly*, 32(1), 54-76. <https://doi.org/10.1598/RRQ.32.1.4>
- O'Sullivan, E. (2010). *Comparative children's literature*. Epicenter. <https://doi.org/10.4324/9780203508664>
- Rice, D. C. (2002). Using trade books in teaching elementary science: Facts and fallacies. *The Reading Teacher*, 55(6), 552-565. <http://www.jstor.org/stable/20205097>
- Schussler, E. E. (2008). From flowers to fruits: How children's books represent plant reproduction. *International Journal of Science Education*, 30(12), 1677-1696. <https://doi.org/10.1080/09500690701570248>
- Trundle, K. C., Troland, T. H., & Pritchard, T. G. (2008). Representations of the moon in children's literature: An analysis of written and visual text. *Journal of Elementary Science Education*, 20(1), 17-28. <https://doi.org/10.1007/BF03174700>
- Zipes, J. (2012). *The irresistible fairy tale*. Princeton University Press. <https://doi.org/10.1515/9781400841820>

Zipes, J. (2015). *The Oxford companion to fairy tales*. Oxford University Press. <https://doi.org/10.1093/acref/9780199689828.001.0001>